Sm/Nd garnet geochronology: Higher precision on smaller samples

E.F. BAXTER*, A.D. POLLINGTON, B. DRAGOVIC, M.K. JORDAN AND J.D. INGLIS

Boston University, Department of Earth Science, Boston MA, 02215, USA (*correspondence: efb@bu.edu)

Despite its recognized utility, Sm-Nd garnet geochronology can be frustrated by two well documented limitations: 1. small Nd sample size resulting in poor analytical precision, and 2. the susceptibility of garnet to contamination by REE rich inclusions which can result in low Sm/Nd ratios. Here we present recent data from Sifnos (Greece), the Tauern Window (Austria), Antarctica, and New England (USA) to illustrate how these limitations can be surmounted and demonstrate the strengths of modern garnet Sm-Nd geochronology.

Recent advances in thermal ionization mass spectrometry including the use of NdO+ analysis have improved the precision of 143Nd/144Nd on small samples. Using single Re filaments and a Ta2O5 activator slurry, we achieve sub-10ppm internal precision and 10-20ppm long term external precision on 4 nanogram Nd standards and natural samples [1]. This permits high precision analysis of very small clean garnet separates (>4mg) – or microzones within individual garnets – depending on garnet Nd concentration, which is often <1ppm. Because partial dissolution cleansing of garnets often results in >50% sample loss, the practical lower limit of crushed, hand-picked starting garnet (before partial disolution) is ~10mg (if 10ppm analytical precision is to be achieved).

Given a two-point garnet-matrix isochron, 10ppm (2σ) analytical precision on garnet (and matrix) 143Nd/144Nd analysis will produce sub-million year age precision (2σ) for any garnet whose 147Sm/144Nd exceeds about 1.2. HF-based partial dissolution cleansing of garnets, can provide sufficiently high 147Sm/144Nd ratios (between 1.0 and 5.0). We have found that each new sample suite presents new challenges that must be overcome with experimentation and modifications to the partial dissolution protocol to optimize cleansing. Key adjustable parameters include: temperature, duration, and grain size of the mineral separate. In most cases, we have found much greater success cleansing finely crushed separates (100-200 mesh), rather than powdered separates. The ability to achieve sub-million year age precision even on very small (>10mg) garnet samples represents the primary strength of Sm-Nd garnet geochronology.

[1] Harvey & Baxter (2009) *Chem. Geol*. **258**, 251-257.

Long duration and multiphase plume basic magmatism with PGE and Cu-Ni Ores for the Paleoproterozoic Baltic Shield

TAMARA BAYANOVA AND FELIX MITROFANOV

Geological Institute Kola Science Centre, Russian Academy of Sciences, Fersman str.14, Apatity Murmansk regions, 184200, Russia

There are two 300-500 km long belts of Paleoproterozoic layered intrusions: the Northen (Kola) Belt and the Southern (Fenno-Karelian) Belt in the Baltic (Fennoscandian) Shield. New U-Pb (TIMS) ages and radiogenic isotopic (Nd-Sr-He) data have been determined for mafic-ultramafic Cu-Ni-Ti-Cr and PGE-bearing layered intrusions of the Kola Belt. U-Pb ages on zircon and baddeleyite for gabbronorite and anorthosite from the Fedorovo-Pansky, Monchepluton and Main Ridge (Monchetundra and Chunatundra), Mt. Generalskaya intrusions and gabbronorite and dykes from the Imandra lopolith of the Kola Belt define a time interval of more than 130 million years, from ca. 2.52 Ga to2.39 Ga. At least four intrusive phases have been distinguished: three PGE-bearing, and one barren. This spread of ages is wider than that for intrusions of the Fenno-Karelian Belt which clusters at 2.44 Ga. Nd isotopic values for the Northern Belt range from 1.1 to -2.4, implying an enriched mantle "EM-1 type" reservoir for these layered intrusions. Initial Sr isotopic data for the rocks of the intrusions are radiogenic relative to bulk mantle, with I_{Sr} values from 0.703 to 0.704. Geochemical data and $^4He/^3He$ isotopic ratios of the mineral reflect a significant contribution from a mantle source rather than the influence of crustal processes during emplacement. The geological and geochronological data indicate that in the eastern part of the Baltic Shield, mafic-ultramafic intrusive magmatism was active over a protacted period and was related to plume magmatism associated with continental breakup that also involved the Superior and Wyoming provinces.

All studies are supported by RFBR 07-05-00956,08-05-00324 and Interreg-Tacis K-0193.